Barcelona Supercomputing Center
Centro Nacional de Supercomputación

RESILIENCE: A semi-operational prototype to predict wind speed at seasonal time scales

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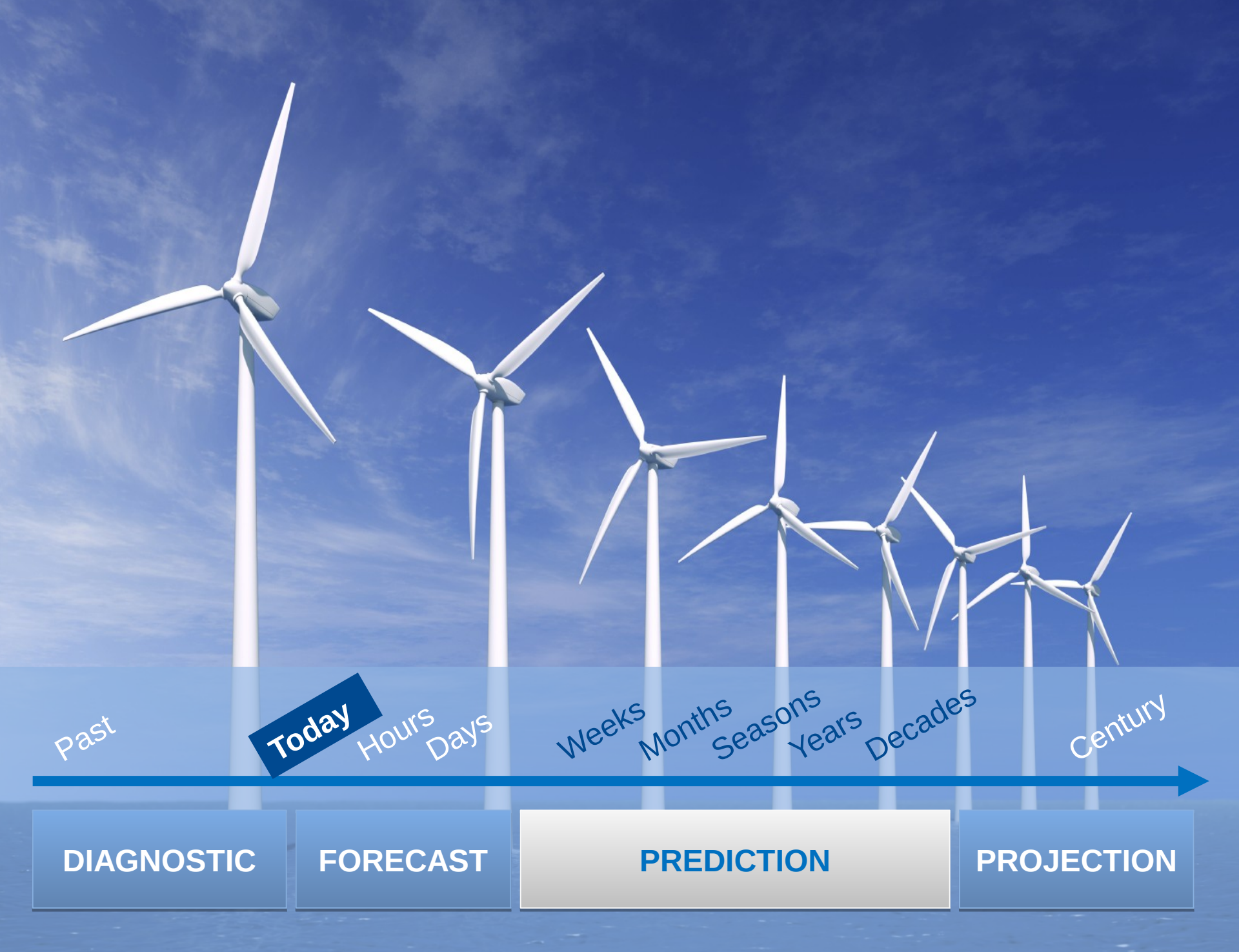
Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

ESS OBJECTIVE:

Facilitate technology transfer of state-of-the-art research from local, national to international levels in five areas:

- Air quality assessments
- Mineral Dust modelling
- Weather forecasting
- **Climate predictions**
- Computational Earth Services


Past
Today
Hours
Days
Weeks
Months
Seasons
Years
Decades
Century
DIAGNOSTIC
FORECAST
PREDICTION
PROJECTION

Climate predictions for wind power

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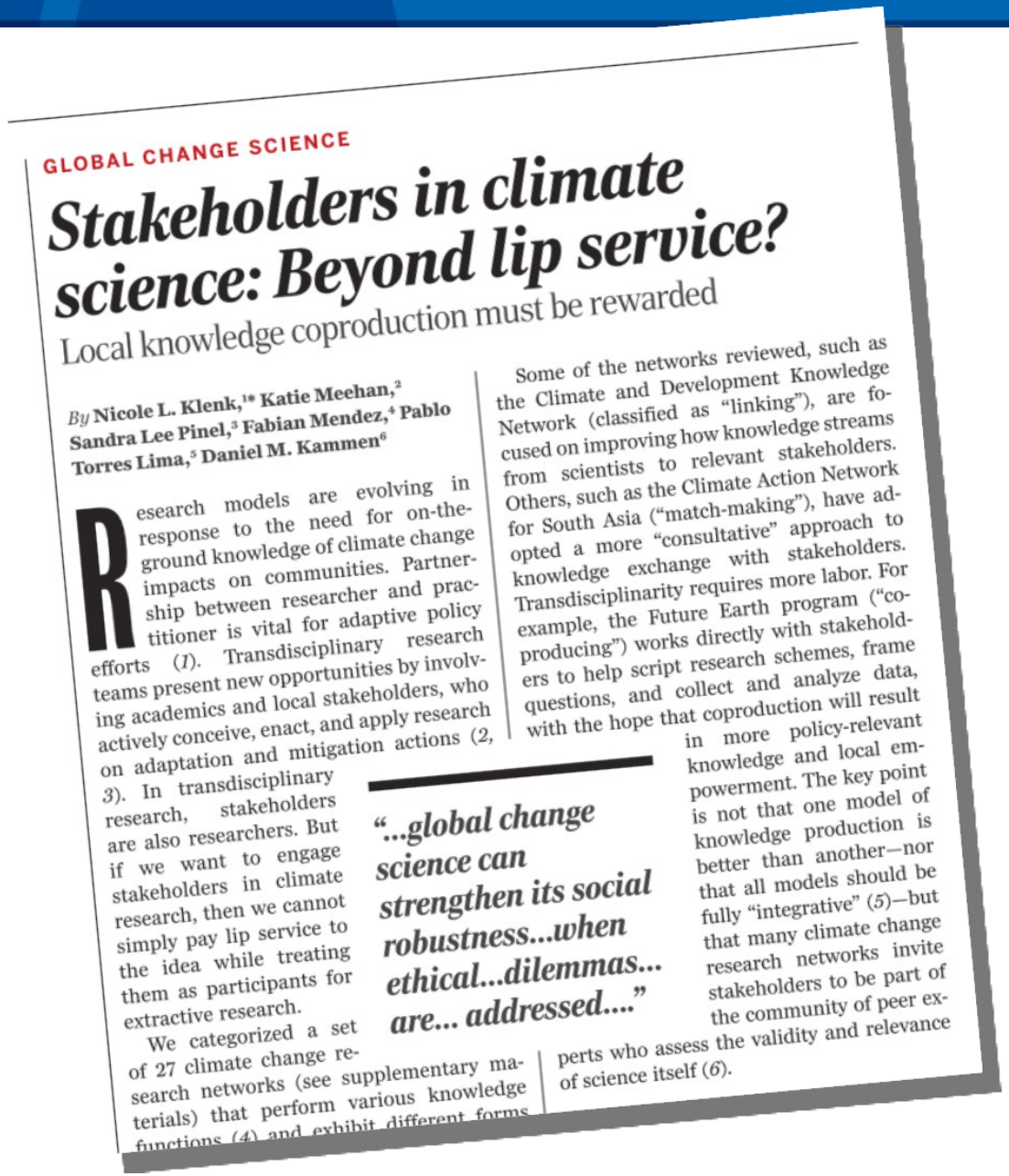
Pre-Construction Decisions: **Annual to Decadal Timescales**

- **Wind farm planners:** Site selection
- **Wind farm investors:** Evaluate return on investments
- **Policy makers:** Understand changes to energy mix

Post-Construction Decisions: **Monthly to Seasonal Timescales**

- **Energy producers:** Resource management strategies
- **Energy traders:** Resource effects on markets
- **Wind farm operators:** Planning for maintenance works
- **Wind farm investors:** Optimize return on investments

User engagement with stakeholders



GLOBAL CHANGE SCIENCE

Stakeholders in climate science: Beyond lip service?

Local knowledge coproduction must be rewarded

By **Nicole L. Klenk,[1]* Katie Meehan,[2] Sandra Lee Pinel,[3] Fabian Mendez,[4] Pablo Torres Lima,[5] Daniel M. Kammen[6]**

Research models are evolving in response to the need for on-the-ground knowledge of climate change impacts on communities. Partnership between researcher and practitioner is vital for adaptive policy efforts (*1*). Transdisciplinary research teams present new opportunities by involving academics and local stakeholders, who actively conceive, enact, and apply research on adaptation and mitigation actions (*2*, *3*). In transdisciplinary research, stakeholders are also researchers. But if we want to engage stakeholders in climate research, then we cannot simply pay lip service to the idea while treating them as participants for extractive research.

We categorized a set of 27 climate change research networks (see supplementary materials) that perform various knowledge functions (*4*) and exhibit different forms

Some of the networks reviewed, such as the Climate and Development Knowledge Network (classified as "linking"), are focused on improving how knowledge streams from scientists to relevant stakeholders. Others, such as the Climate Action Network for South Asia ("match-making"), have adopted a more "consultative" approach to knowledge exchange with stakeholders. Transdisciplinarity requires more labor. For example, the Future Earth program ("co-producing") works directly with stakeholders to help script research schemes, frame questions, and collect and analyze data, with the hope that coproduction will result in more policy-relevant knowledge and local empowerment. The key point is not that one model of knowledge production is better than another—nor that all models should be fully "integrative" (*5*)—but that many climate change research networks invite stakeholders to be part of the community of peer experts who assess the validity and relevance of science itself (*6*).

"...global change science can strengthen its social robustness...when ethical...dilemmas... are... addressed...."

Klenk et al.
13 Nov 2015 Science

Climate services for energy

ESS partnership in EU Projects in climate services for the energy sector

SPECS: Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

EUPORIAS: EUropean Provision Of Regional Impact Assessment on a Seasonal-to-decadal timescale

NEWA: New European Wind Atlas

PRIMAVERA: Process-based climate simulation: advances in high-resolution modelling and european climate risk assessment

IMPREX: Improving predictions and management of hydrological Extremes

CLIM4ENERGY: Climate for Energy

EUPORIAS – Energy prototype

EUPORIAS

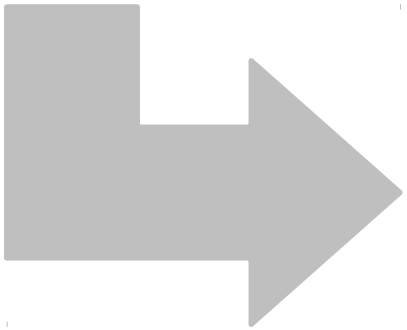
One of the specific objectives of EUPORIAS is:

To develop a few **fully working prototypes** of climate services

addressing the need of **specific users**,

show how climate predictions could **impact their decision-making processes**

and ultimately encourage them to **use the prototypes**.

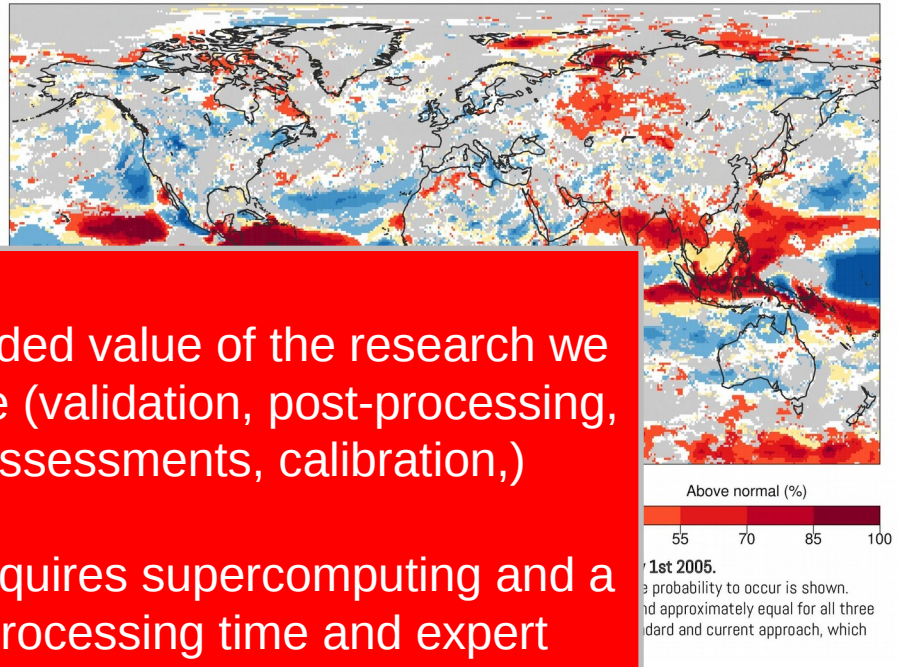


RESILIENCE

PROTOTYPE

RESILIENCE: Seasonal wind speed predictions for the Energy sector

Semi-operational prototype that aims to provide information on **seasonal wind speed** variability based on **probabilistic climate predictions**.



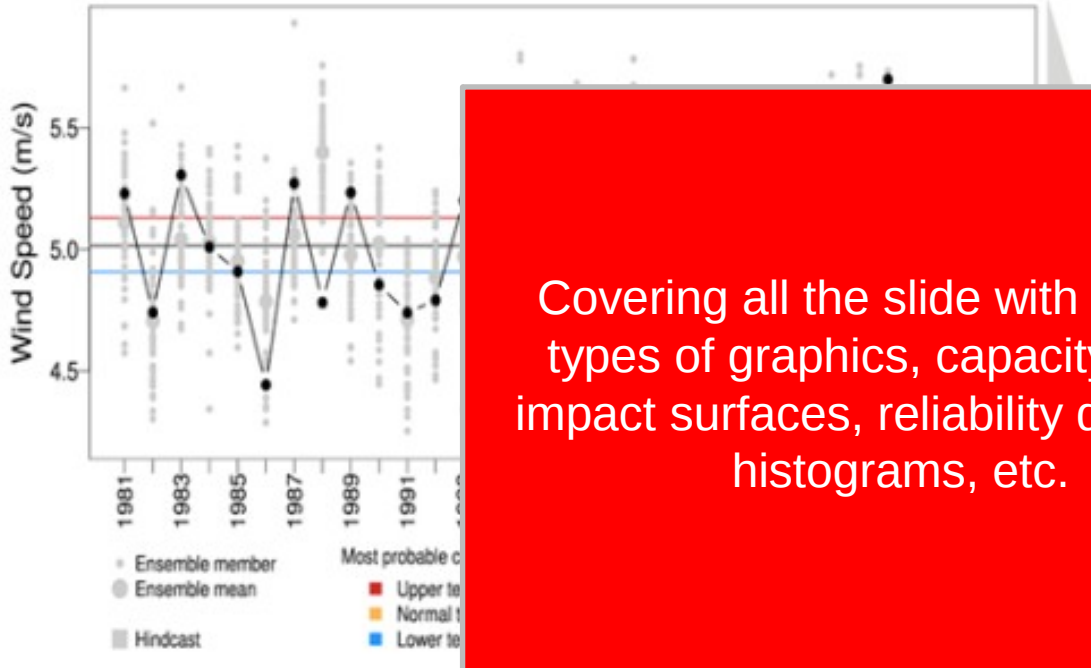
e added value of the research we done (validation, post-processing, kill assessments, calibration,)

all requires supercomputing and a of processing time and expert dvise in the data downloading adaptation, etc.

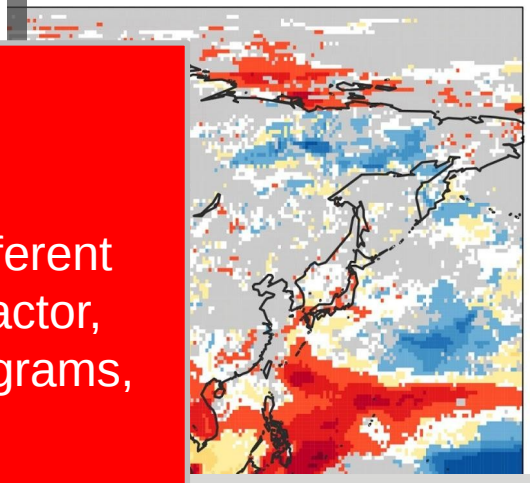
- Data from **ECMWF**, prediction system: System 4
- Global domain
- Probabilistic predictions
- Aggregated output in **terciles**:
  - Above normal
  - Normal
  - Below normal
- Operational prediction for **Winter 2015/2016**

b

Time series of 10–m wind speed calibrated from ECMWF System 4 and ERA–Interim reanalysis (DJF 1981–2009)



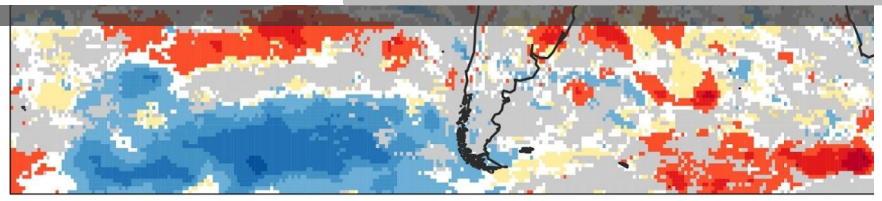
Covering all the slide with different types of graphics, capacity factor, impact surfaces, reliability diagrams, histograms, etc.

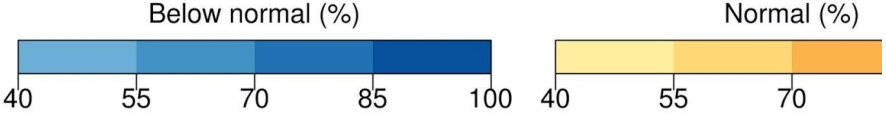


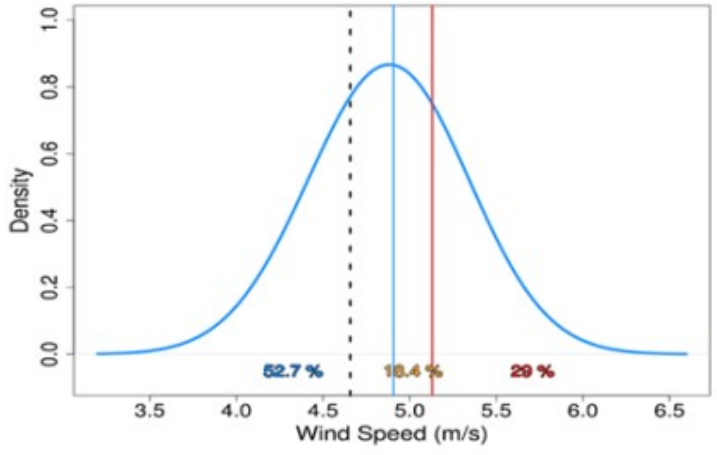
d probability density prediction)

c

RPSS=0.226 CRPSS=0.115

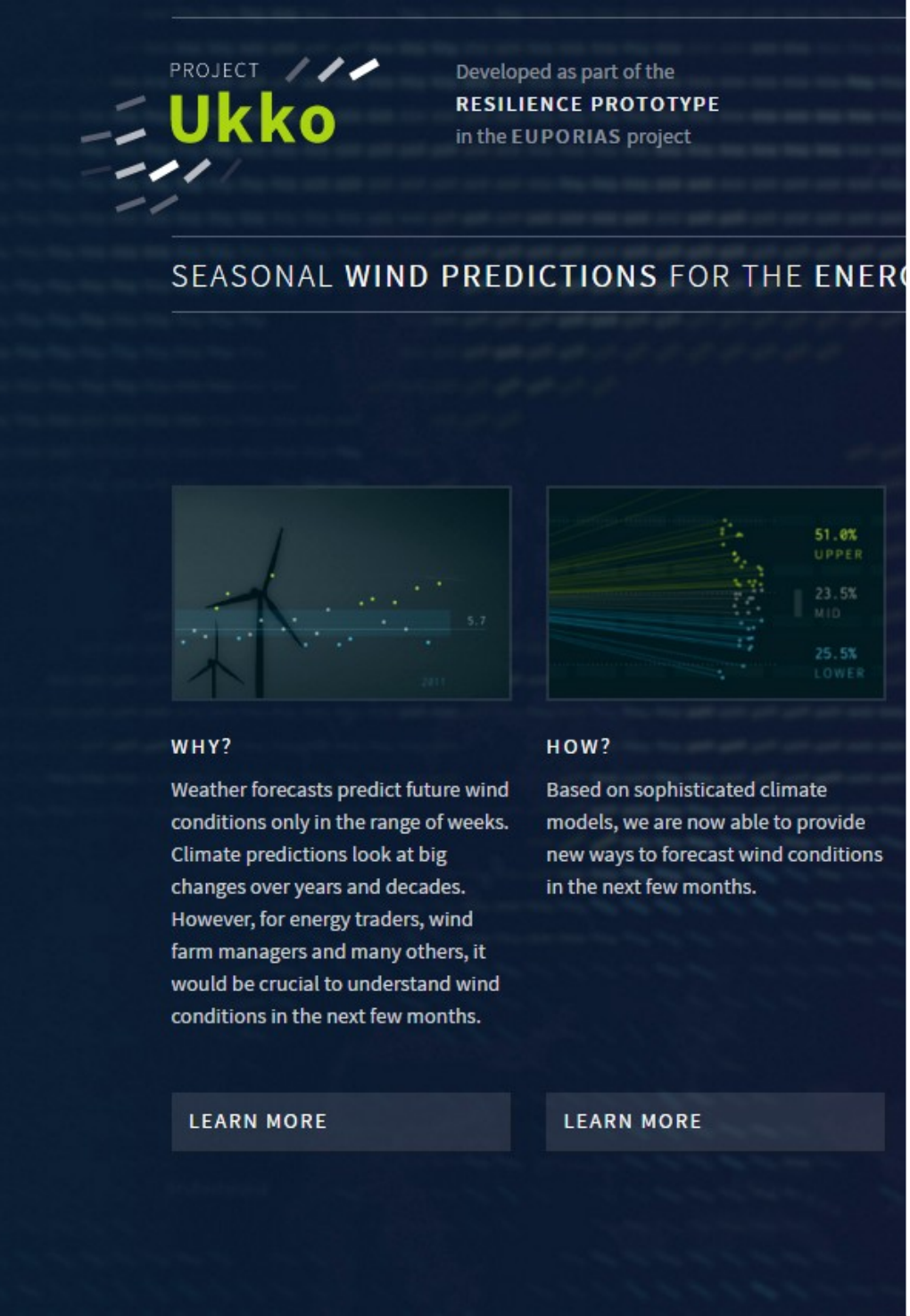






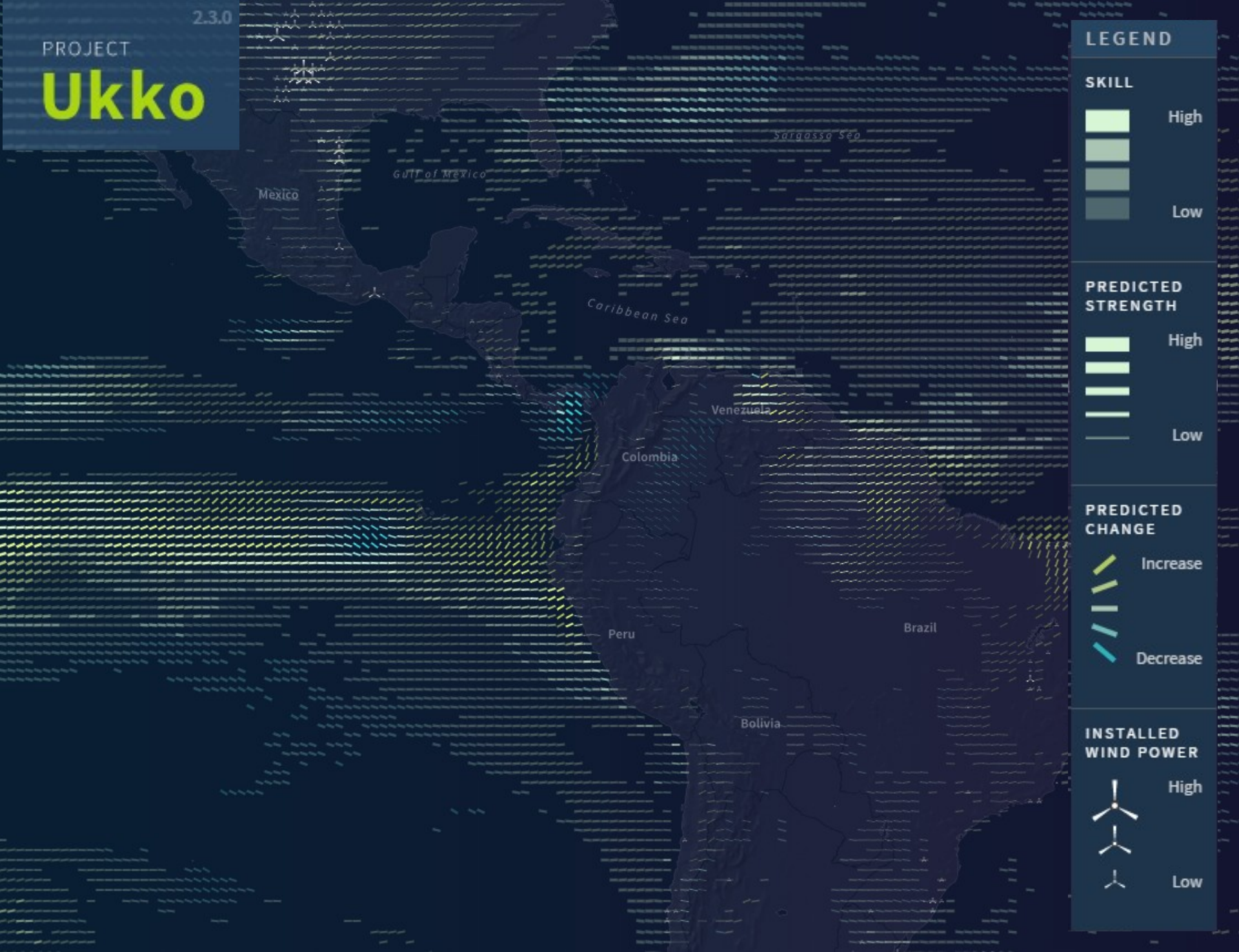
Wind speed prediction for June 1st - August 31s

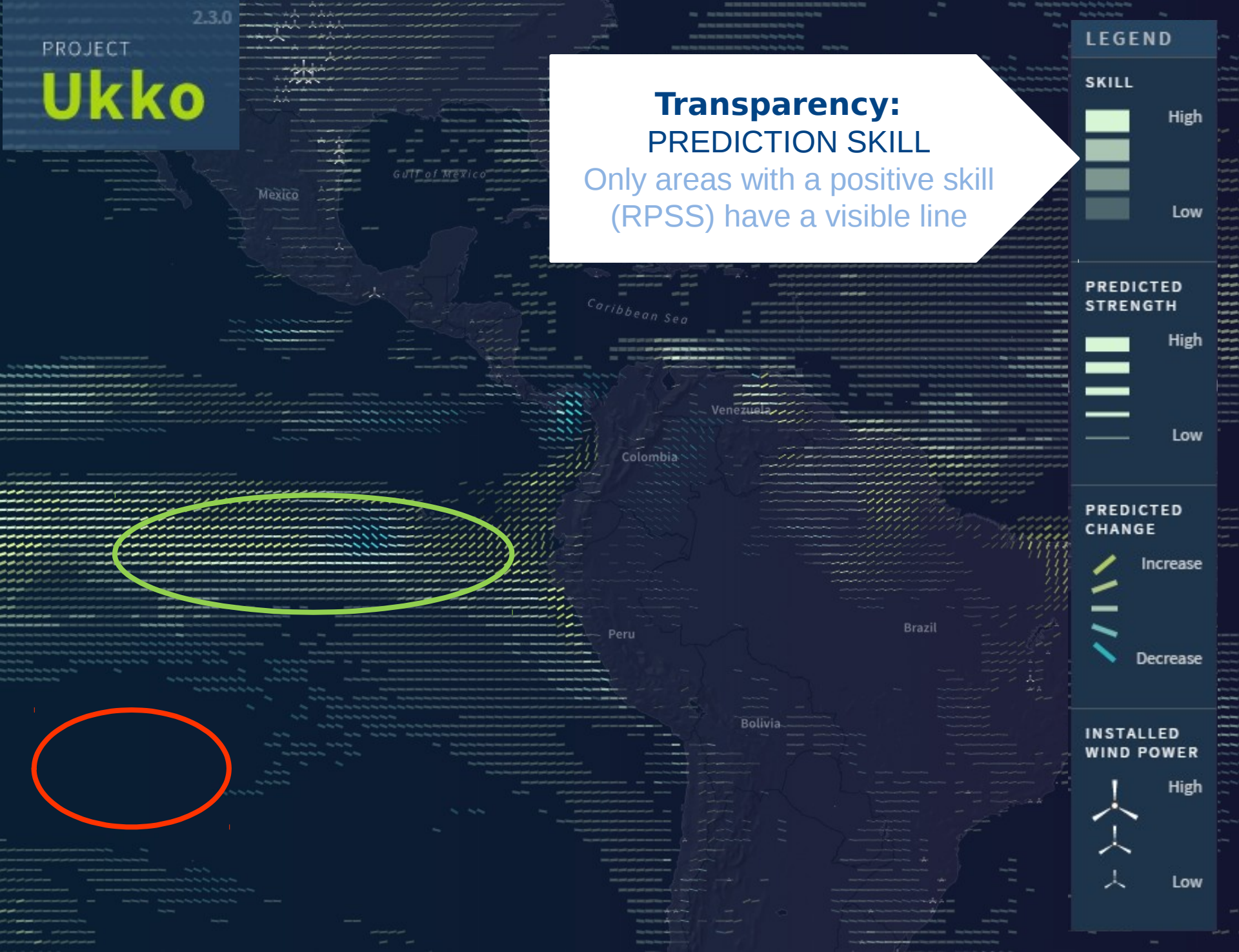
The most likely wind power category (below normal, normal or above norm
"Normal" represents the average of the past. White areas show where the
categories. Grey areas show where the climate prediction model does not
projects past climate data into the future.



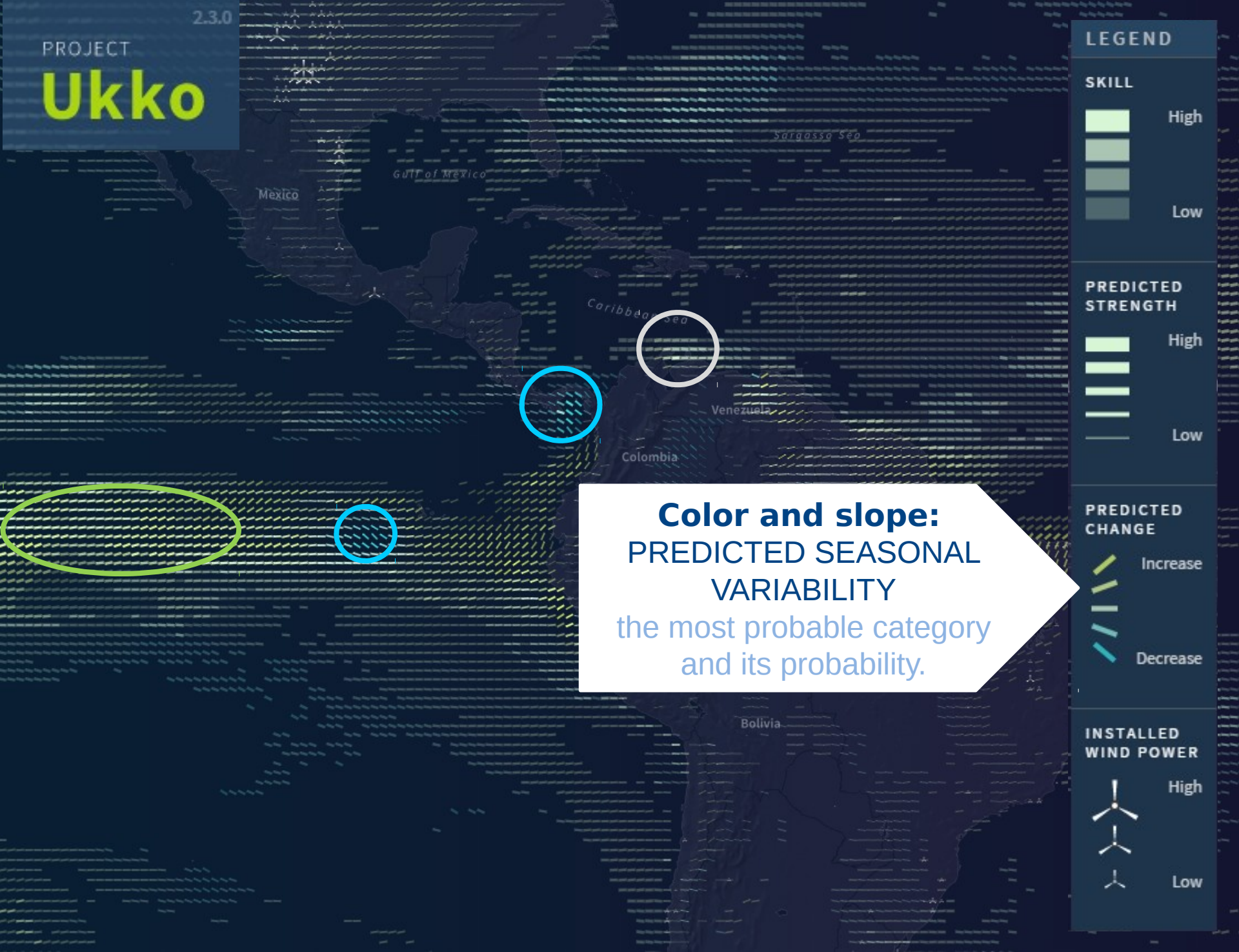
From the 6 prototypes developed within EUPORIAS, our prototype was selected to make a visualisation exercise

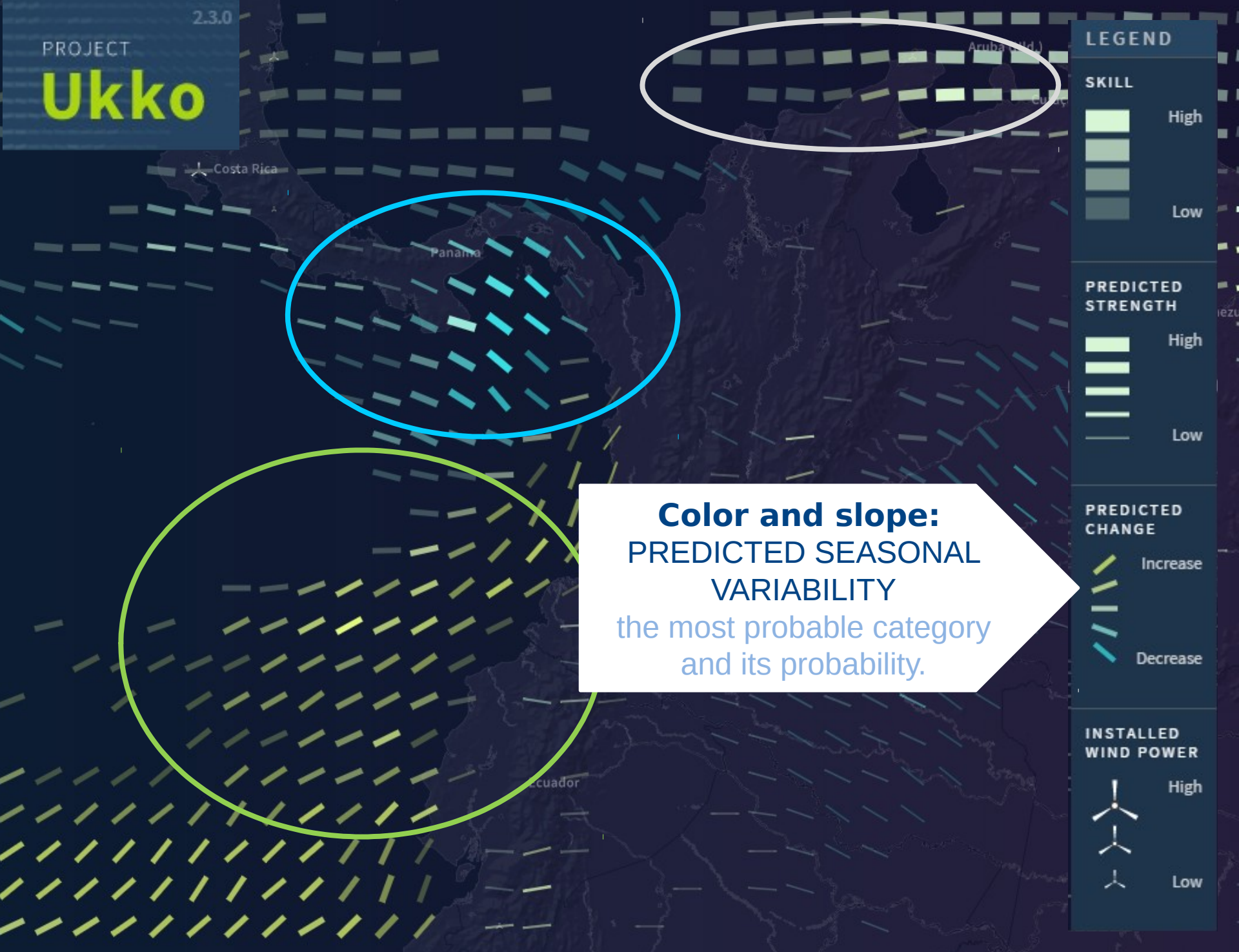
- On-line **visualisation tool** of RESILIENCE
- **Joint development** between scientists and designers
- Renowned data visualiser, **Mortiz Stefaner**
- User Interface Platform (**UIP**)

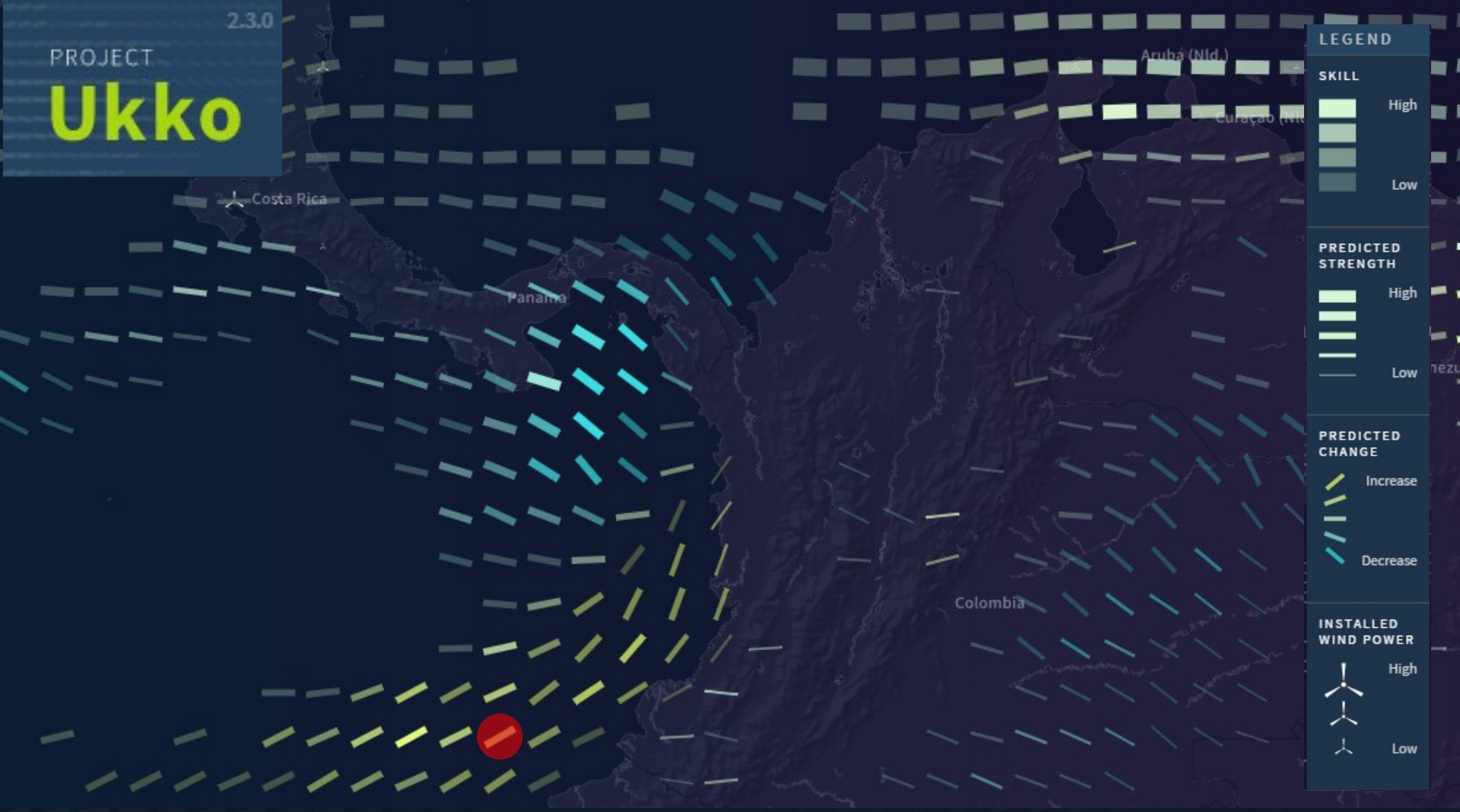

2.3.0
PROJECT
Ukko
Sargasso Sea
Gulf of Mexico
Mexico
Caribbean Sea
Venezuela
Colombia
Peru
Brazil
Bolivia
LEGEND
SKILL
High
Low
PREDICTED STRENGTH
High
Low
PREDICTED CHANGE
Increase
Decrease
INSTALLED WIND POWER
High
Low


2.3.0
PROJECT
Ukko
Transparency:
PREDICTION SKILL
Only areas with a positive skill (RPSS) have a visible line
LEGEND
SKILL
High
Low
PREDICTED STRENGTH
High
Low
PREDICTED CHANGE
Increase
Decrease
INSTALLED WIND POWER
High
Low
Mexico
Gulf of Mexico
Caribbean Sea
Venezuela
Colombia
Peru
Brazil
Bolivia


2.3.0
PROJECT
Ukko
Caribbean Sea
Venezuela
Colombia
Suriname
Line width:
PREDICTED WIND SPEED
mean wind speed predicted for the coming season.
LEGEND
SKILL
High
Low
PREDICTED STRENGTH
High
Low
PREDICTED CHANGE
Increase
Decrease
INSTALLED WIND POWER
High
Low


2.3.0
PROJECT
Ukko
Mexico
Gulf of Mexico
Sargasso Sea
Caribbean Sea
Venezuela
Colombia
Bolivia
Color and slope:
PREDICTED SEASONAL VARIABILITY
the most probable category and its probability.
LEGEND
SKILL
High
Low
PREDICTED STRENGTH
High
Low
PREDICTED CHANGE
Increase
Decrease
INSTALLED WIND POWER
High
Low


2.3.0
PROJECT
Ukko
Costa Rica
Panama
Ecuador
LEGEND
SKILL
High
Low
PREDICTED STRENGTH
High
Low
PREDICTED CHANGE
Increase
Decrease
INSTALLED WIND POWER
High
Low
Color and slope:
PREDICTED SEASONAL VARIABILITY
the most probable category and its probability.



OBSERVATIONS

Seasonal average wind speeds in m/s

PREDICTIONS

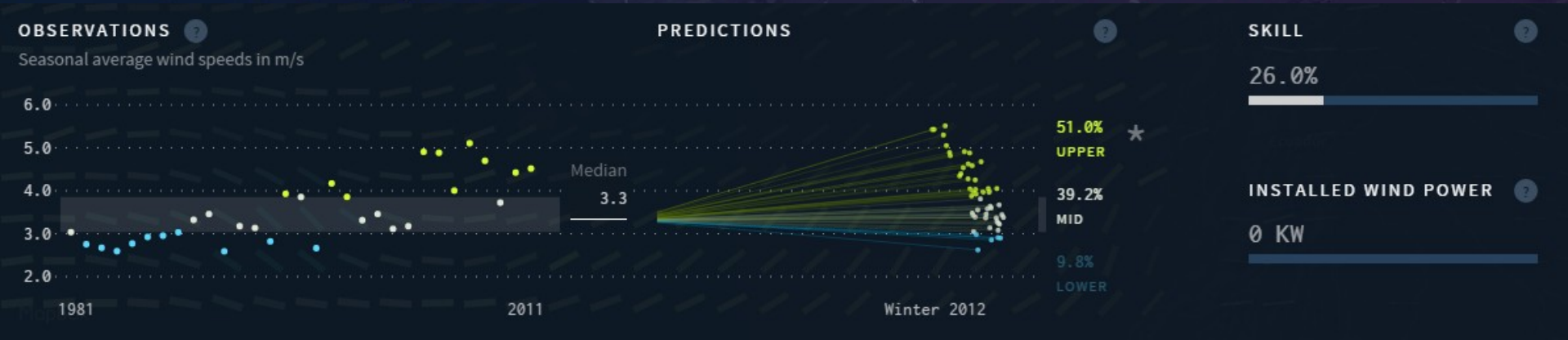
SKILL

26.0%

INSTALLED WIND POWER

0 KW


2.3.0
PROJECT
Ukko
Costa Rica
Panama
Aruba (Nld.)
LEGEND
SKILL
High
Low
PREDICTED STRENGTH
High
Low
PREDICTED CHANGE
Increase
Low
OBSERVATIONS
ERA-Interim 10-m wind speed reanalysis
PREDICTIONS
the most probable category and its probability.
SKILL
RPSS skill score


OBSERVATIONS
Seasonal average wind speeds in m/s
6.0
5.0
4.0
3.0
2.0
Median
3.3
1981
2011
PREDICTIONS
51.0%
UPPER
39.2%
MID
9.8%
LOWER
Winter 2012
SKILL
26.0%
INSTALLED WIND POWER
0 KW

LESSONS LEARNT

GLOBAL CHANGE SCIENCE

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"...global change science can strengthen its social robustness...when ethical...dilemmas... are... addressed...."

Our main lesson learnt from the process of developing the visualisation tool:

Designers and Scientists have **different perspectives** on how information should be displayed.

To have a good visualisation it is key to have the **end user closely involved** in all the steps of the visualisation development.

Klenk et al.
13 Nov 2015 Science

www.bsc.es

Thank you!

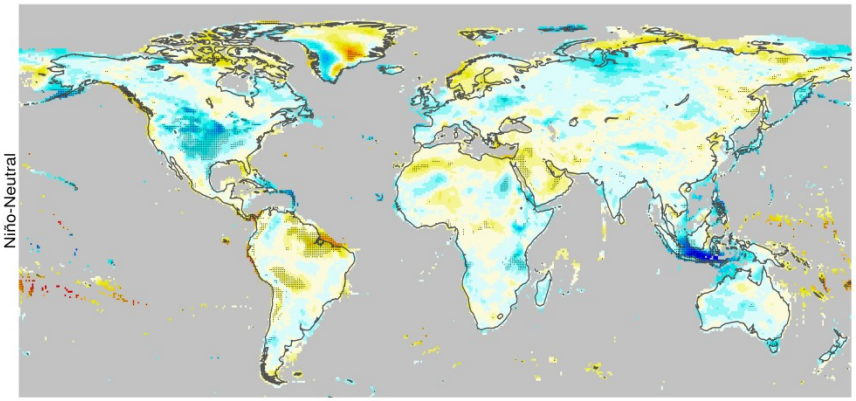
e.g. Climate drivers of seasonal variability

DJF Wind difference (ONI), 1981-2014 (m/s)

DJF Wind difference (NAO), 1981-2014 (m/s)

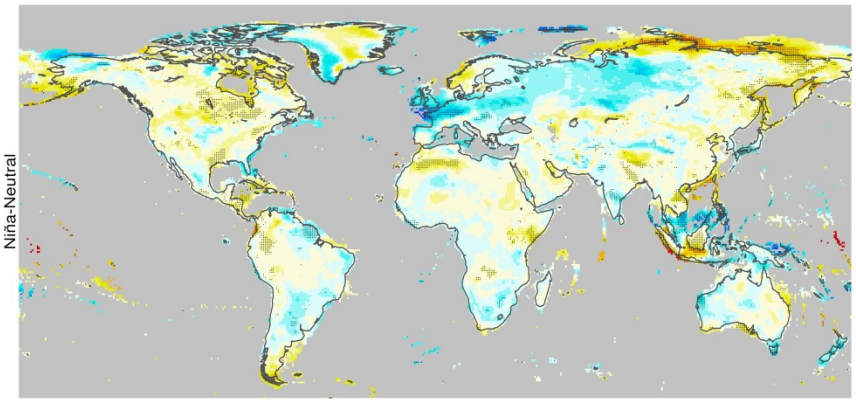
Niño

Niño-Neutral



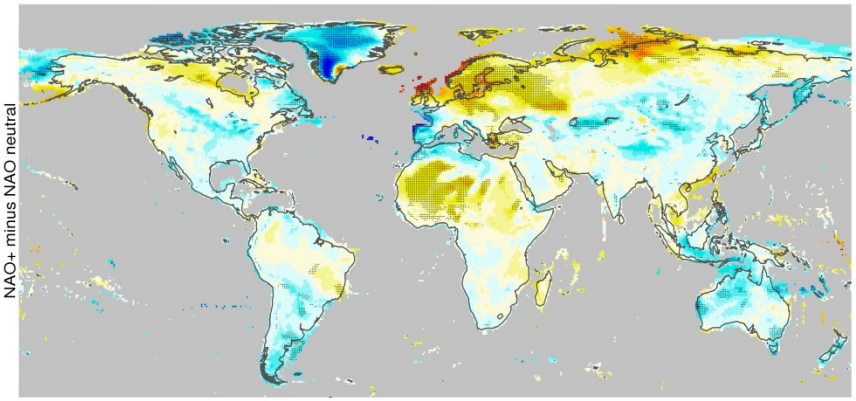
Niña

Niña-Neutral



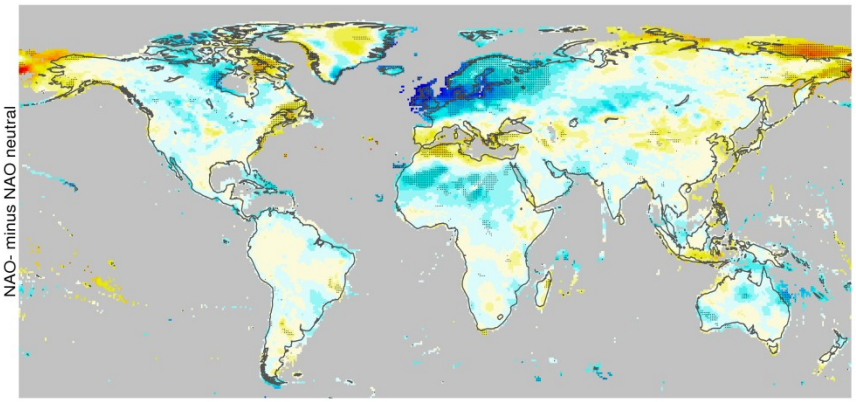
NAO +

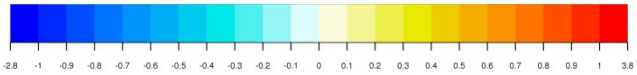
NAO+ minus NAO neutral



NAO -

NAO- minus NAO neutral





Skill map for sub-seasonal

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Correlation of ECMWF Monthly Prediction System
10m Wind Speed for Jan_Feb. Forecast time 12–18.